

LESSON 3: Keeping Items Cycled

LESSON'S CONCEPTS

- Everything people make, use, and discard comes from natural resources.
- Most products made by people can be kept out of landfills and kept in a cycle through reusing and recycling.

PURPOSE

Students determine ways to extend the life cycle of various objects.

OVERVIEW

In this lesson students will:

- Classify objects they brought to class according to the category of natural resources from which the objects were made.
- Develop a list of questions to find out what natural resources were used and the steps that it took to make a particular object.
- Work in groups to do the necessary research to answer their list of questions about an object they select and the ways that object can be kept out of a landfill.
- Determine how reusing or recycling extends the “life cycle” of an object.
- Present to the class their reports on how to keep an object out of a landfill.

CORRELATIONS TO CALIFORNIA'S CONTENT STANDARDS AND FRAMEWORKS AND TO BENCHMARKS FOR SCIENCE LITERACY

- Students identify ways that the life cycle of certain objects can be extended (e.g., through reusing and recycling) to keep them out of landfills.
 - “Discarded products contribute to the problem of waste disposal. Sometimes it is possible to use the materials in them to make new products, but materials differ widely in the ease with which they can be recycled.” (*Benchmarks for Science Literacy*, page 189)
 - “Many materials can be recycled and used again . . .” (*Benchmarks for Science Literacy*, page 119)

- “Some materials can be used over again.” (*Benchmarks for Science Literacy*, page 188)
- Students work together to answer questions about the steps that it took to make a particular item and the ways in which its life cycle can be extended.
 - “Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. As a basis for understanding this concept, students know . . . (the) natural origin of the materials used to make common objects.” (*Science Content Standards, Grades K–12; Grade 6; Resources, Standard 6c*)
- Students present their reports on how to keep an object out of a landfill and listen to presentations by other students.
 - “Students listen critically and respond appropriately to oral communication. They speak in a manner that guides the listener to understand important ideas by using proper phrasing, pitch, and modulation.” (*English–Language Arts Content Standards for California Public Schools, Kindergarten Through Grade Twelve*, page 26)

SCIENTIFIC THINKING PROCESSES

observing, communicating, comparing, ordering, classifying, inferring

TIME

30 minutes to prepare for the lesson; 45 minutes for Part I; 60–90 minutes for the research and presentations

VOCABULARY

life cycle

PREPARATION

- 1. Read the “Background Information for the Teacher” at the end of this lesson.
- 2. Ask students to bring to class one object (made from one natural resource) that was going to be discarded. Have several objects available for those students who did not bring an object; for example, a plastic container or bag, paper bag, a cotton rag, and a piece of aluminum foil.
- 3. Make or have students create a sign for each the following categories of natural resources: plants, animals, minerals, fossil fuels.
- 4. Make transparencies and a copy of each of the following illustrations located at the end of this lesson:
 - “Examples of Questions Concerning the Life Cycle of an Item”
 - “Life Cycle of a Tree”
 - “Papermaking: One Way or a Cycle?”
 - “Paper Manufacturing”
 - “Recycled Paper Manufacturing”
 - “Aluminum Can Manufacturing”
 - “Recycled Aluminum Manufacturing”
 - “Glass Manufacturing”
 - “Recycled Glass Manufacturing”
 - “Steel Can Manufacturing”
 - “Recycled Steel Can Manufacturing”
 - “Plastic Manufacturing”
 - “Recycled Plastic Manufacturing”

MATERIALS

- Piece of butcher paper on which to record students’ responses
- Leather belt
- A sign for each the following natural resources: plants, animals, minerals, and fossil fuels
- One copy and one transparency of each of the illustrations listed in “Preparation” #4.

PRE-ACTIVITY QUESTIONS

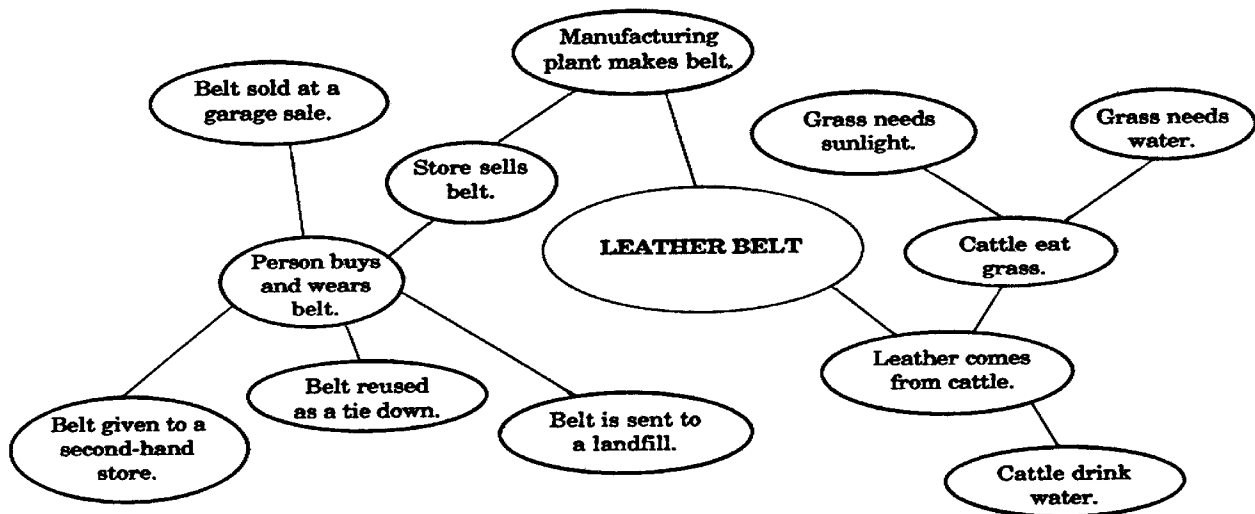
- A. Project the transparency of a “Life Cycle of a Tree.” Ask students:
 - What is a cycle? *Something that occurs over and over again.*
 - What are some examples of life cycles?

Human, insect, bird.

- What other cycles exist in nature? *Seasons, water cycle, soil cycle.*
- B. Project the transparency of “Papermaking: One Way or a Cycle?” Ask students:
 - How is this cycle different from the life cycle of a tree? *The life cycle of a tree goes on and on, whereas the papermaking cycle may not be a cycle but can stop after the item is used and then taken to a landfill.*
 - How can we keep an object from ending up in a landfill? *Reuse it, give it to someone, recycle it.*
 - If objects are sent to the landfill, do they become part of a cycle? *Usually not.*
 - How can an object become part of a cycle? *If it is reused or recycled.*
 - Why don’t people keep more waste out of the landfill? *It is not convenient; they do not want their houses to get full of trash; they don’t know why it is important to do so.*

PROCEDURE

- A. When all students have brought to class one object (made from one natural resource) that was going to be discarded, ask the students to show their objects and identify which category of natural resources each object came from.
- B. In different places in the classroom, place the sign for four categories of natural resources from which most products are made (plants, animals, minerals, fossil fuels). Have students sort their objects into groups by a specific natural resource.
- C. Place a leather belt by the “animal” sign. (This will probably be the smallest pile.) Tell students that the class will analyze the life cycle of this leather belt. This belt will be used as an example of questions that groups of students will answer concerning objects from this and other piles.
- D. Develop with students a list of questions that should be answered to find out where the leather belt came from and what will happen to it after the person who bought it no longer wants it. Examples of questions are listed in “Examples of Questions and Answers Concerning the Life Cycle of a Leather Belt” at the end of this lesson.



1. Write these questions on the chalkboard or on a piece of butcher paper to post in the classroom.
 2. Another way to do this is to develop a mind-map. This is done by placing the words "leather belt" in the middle of a large piece of butcher paper or on the chalkboard. Have students come up with different ideas about the life cycle of the belt and place these ideas in bubbles around the item. Each bubble can also have its own connections with its own set of bubbles.
- E. Have students form groups based on the natural resource that was used to make the objects they brought. For example, have students who brought objects that are now in the plant pile form a group. There will be four groups: plants, animals, minerals, and fossil fuels.

Note: If the groups are too large, split groups into two or more groups. Each group can select a different item to analyze.

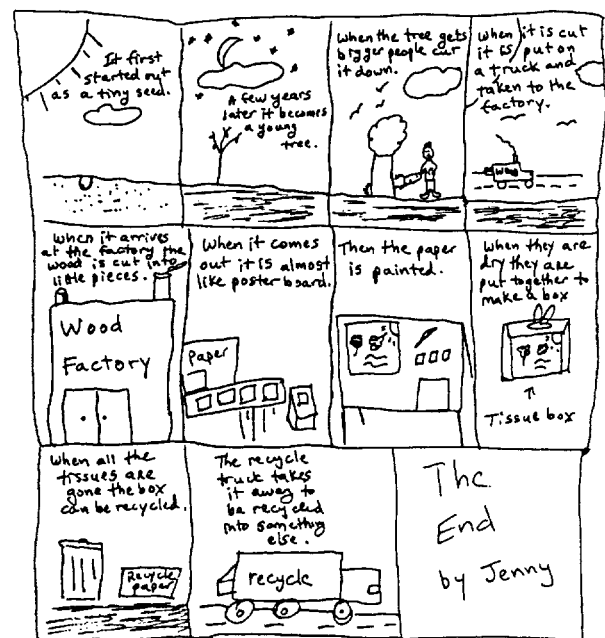
- F. Ask each group to select one item. Develop a set of questions to learn more about this item. (Examples of questions are listed in "Examples of Questions Concerning the Life Cycle of an Item" at the end of this lesson.) Have students within the group list and draw the life cycle of this item. They should:
- Consider all the steps that it took to make this item.
 - Include a scene showing where the natural resource once was, how it was obtained by people, how it arrived at

the place where it will be processed, and how it might have been processed.

- Describe how this item can remain in a cycle to conserve natural resources.
- Answer the questions that they developed or the questions in "Examples of Questions Concerning the Life Cycle of an Item."

- G. Have groups present their answers. Students can identify the similarities and differences of each object's life cycle.

Homework Assignment: Ask students to select an object from home that is made from one natural resource. Ask them to draw a series of illustrations of what it took to make this object.



Submitted by Ed Malaret, fifth-grade teacher, Marguerite Hahn Elementary School, Cotati-Rohnert Park Unified School District.

Then they will need to describe where this object will go once it is no longer useful and how its life cycle can be extended.

- H. Ask students to share their homework assignments in groups.

DISCUSSION/QUESTIONS

- A. Discuss with students:

- What are ways that we can extend the life cycle of objects? *Recycle them, reuse them, or give them to someone else to use.*
- Why is it important to keep natural resources from going to landfills? *To keep the landfills from filling up rapidly; to save natural resources so less will need to be acquired from the natural environment.*
- What can be done to keep an old T-shirt that is no longer wanted by its owner out of a landfill? *Give it to someone else; use it as a dust rag; make a section of a quilt out of it; weave it into a throw rug.* Tell students that if the T-shirt is made from cotton, it can also be composted to enrich soil to grow plants.

APPLICATION

- A. Separate the class into five groups. Give the following copies and corresponding transparencies to each group:

Group 1: "Paper Manufacturing" and "Recycled Paper Manufacturing."

Group 2: "Aluminum Can Manufacturing" and "Recycled Aluminum Manufacturing."

Group 3: "Glass Manufacturing" and "Recycled Glass Manufacturing."

Group 4: "Steel Can Manufacturing" and "Recycled Steel Can Manufacturing."

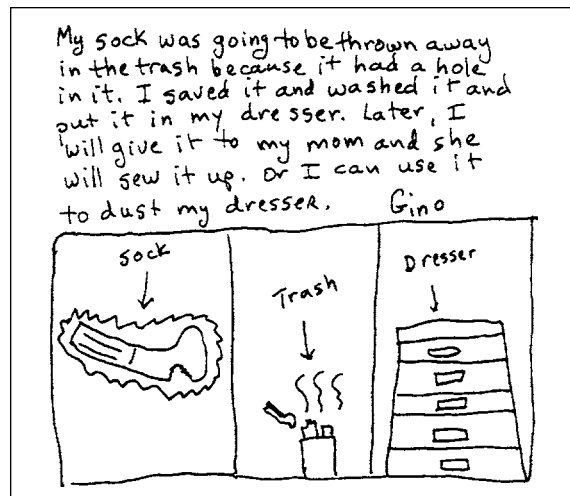
Group 5: "Plastic Manufacturing" and "Recycled Plastic Manufacturing."

- B. Ask groups to prepare a short presentation to show the class the differences between manufacturing items from raw materials compared to using recycled materials. Encourage students to use the transparencies during their presentations. Each student must participate in some part of the presentation.

- C. Discuss with the class how recycling conserves natural resources.

Homework Assignment: Have students select an

item that was being discarded at home. Ask them to describe what it will take to keep this item in the loop or to extend the life cycle of this item. They should also describe why this item might not be kept in a cycle. Tell students that they should be prepared to discuss their items within a group the following day.



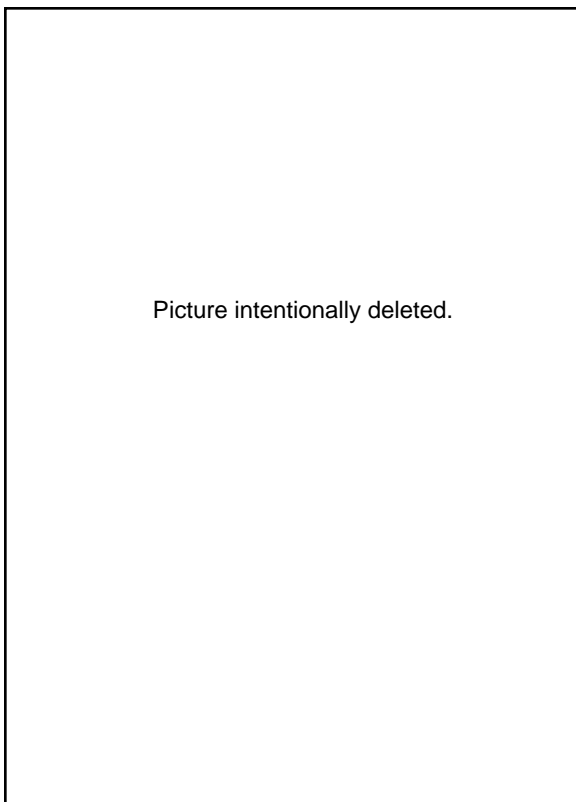
Submitted by Ed Malaret, fifth-grade teacher, Marguerite Hahn Elementary School, Cotati-Rohnert Park Unified School District.

- D. The following day, ask students to meet in groups and share their homework assignments. Students should be aware that many objects can be reused or recycled into new products. They should also understand that some items cannot be reused or recycled because they are designed to be used one time (e.g., a toothpick, packaging from some restaurants, paper napkin).

Project Idea: Have students bring in clean pieces of old clothes and braid a class throw rug.

EXTENSIONS

- A. With the whole class, write or recite and record a story of how an item came to be and how its life cycle can be extended. One way to do this is described below:
- Select an item.
 - Have one student in the class begin the story.
 - Have another student add to the story.
 - The goal is to continue the story to allow everyone in the class to add to the story.
 - The ending of the story should indicate that the item will continue to be used and not end up in a landfill.



Two students from Valley Oak Elementary School braided pieces of cloth to make a throw rug.

- B.** Have students work in groups and look at objects made from more than one natural resource. For example:

- Roller-blade (metal, leather, cotton)
- Raincoat (plastic, metal, cotton)
- Bed (metal, wood)
- Desk (metal, wood, plastic)

Ask students to draw the item and label each section with the natural resource from which it came.

RESOURCES

Videos

Recycle It! Northbrook, Ill.: Film Ideas, Inc., 1993 (16 minutes).

A music video featuring the World Patrol Kids who explain how aluminum, plastic, paper, and glass are recycled at industrial plants.

Recycling. Earth Science series. Northbrook, Ill.: Film Ideas, Inc., 1994 (20 minutes).

Shows how products get to market through the mining, milling, and refining of raw materials. Explains why recycling and reprocessing waste are important.

Recycling: The Endless Circle. Washington, D.C.: National Geographic, 1992 (25 minutes).

Explains how recycling returns used materials (e.g., paper, aluminum, and plastic) to make new products, therefore reducing waste.

Books

Brooks, Felicity. *How Things Are Made*. Finding Out About series. Tulsa, Okla.: EDC Publishing, 1989.

Explains from what natural resources things are made. Contains illustrations and descriptions of how some items are made. These include leather shoes, clay pottery, clothing, paper, glass bottles, cans, plastic blocks, and soap.

Jones, George. *My First Book of How Things Are Made*. New York: Scholastic, Inc., 1995.

Explains how crayons, peanut butter, grape jelly, footballs, orange juice, blue jeans, guitars, and books are made. This book can be used to show students ways people make products from plants.

Websites

See "Appendix F–IV, Natural Resources websites."

EXAMPLES OF QUESTIONS AND ANSWERS CONCERNING THE LIFE CYCLE OF A LEATHER BELT

The following example outlines the life cycle of a leather belt:

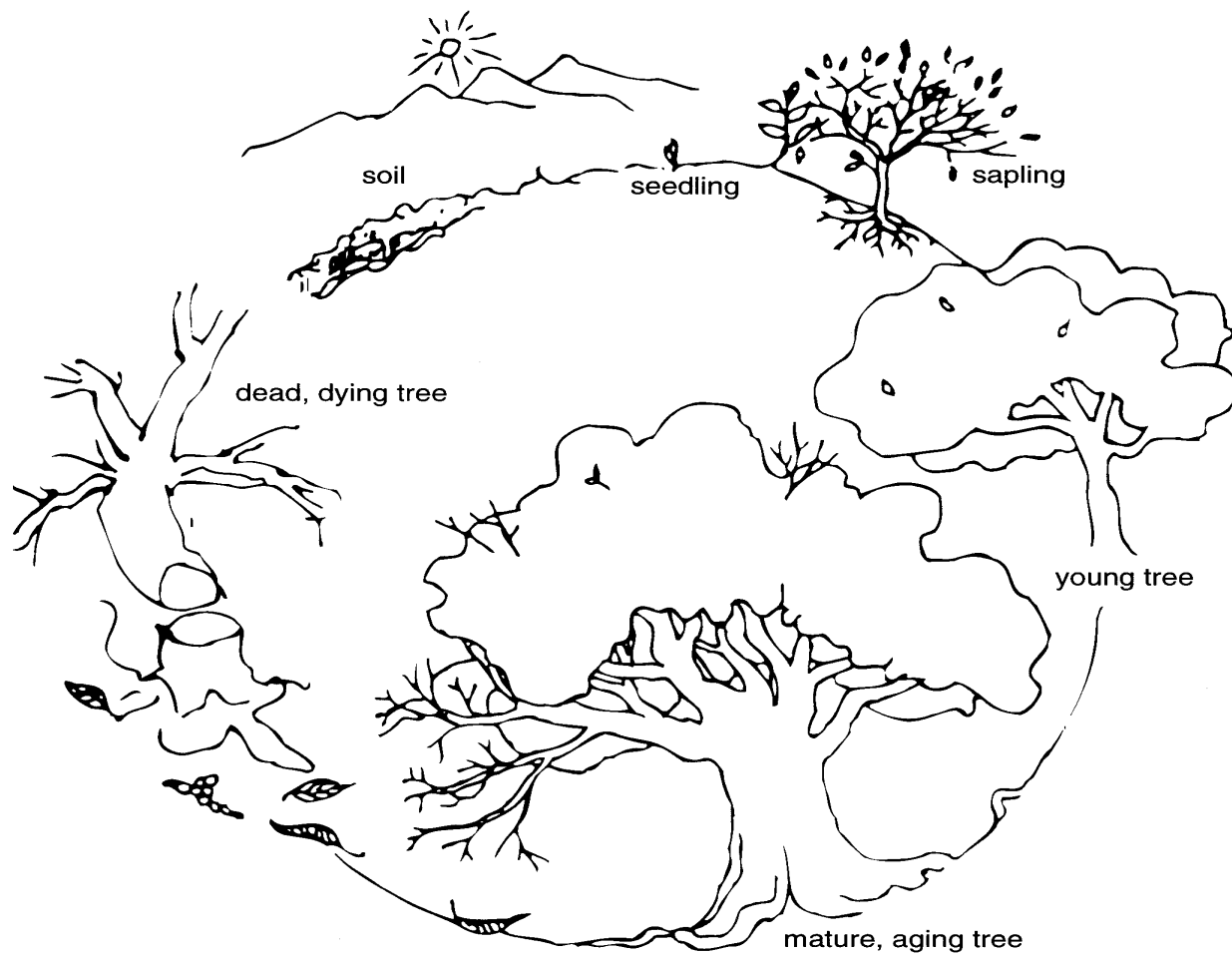
1. From what category of natural resources was this item made? *Animal.*
2. From what type of animal was this item made? *Cow.*
3. Was it a living natural resource or a nonliving one? *Living.*
4. If living, what natural resources did this living thing use when it was alive? *Air, water, plants, soil; the plants the cow ate used sunlight and minerals as well as air and water.*
5. How did a part of it become a belt? *It was killed for food, and part of its hide was used to make the belt.*
6. What natural resources were used for the transportation of the cow and its hide? *Fossil fuels.*
7. What natural resources were needed to make the belt? *The animal, water, fossil fuels.*
8. Might any pollution be caused during the manufacturing process? If so, what natural resources might be polluted? *Maybe water and air.*
9. What happens to the belt after it is made? *It goes to a wholesaler and then to a department store.*
10. Who bought it? *A person.*
11. Why was it bought? *Because the person liked it or needed a belt.*
12. How will it be used by the person who bought it? *As a belt, but possibly as a dog leash, or to secure something on the person's bicycle.*
13. How did the person get to and from the store where the belt was bought and what natural resources were used? *By car that uses fossil fuels and all the natural resources used to make that car.*
14. How long will this person probably keep the belt? *One or two years; until the person gains weight; until the person doesn't want it any longer; until the belt breaks.*
15. What will happen to the belt after the person no longer wants it? *It will go into the trash can and then to the landfill; if it is still in good shape, it could be given to someone, taken to a secondhand store, or sold at a garage sale.*
16. What could the person have done to make sure that the belt didn't break? *The person could make sure that a high quality belt was purchased, that the type of belt bought will always be in style; the person could make sure that he or she does not gain too much weight.*
17. If the belt is headed to the landfill, what can be done to keep it from going to the landfill? *Reuse it or give it away.*
18. If it goes to the landfill anyway, what natural resources were wasted in the making of this item, since it is now being thrown into a landfill? *All the natural resources used by the cow, the fossil fuels in transportation, and the resources used in making the belt.*
19. Can the belt be recycled? *Probably not.*
20. Can the belt be reused? *It could be used for another purpose, such as a tie down.*

EXAMPLES OF QUESTIONS CONCERNING THE LIFE CYCLE OF AN ITEM

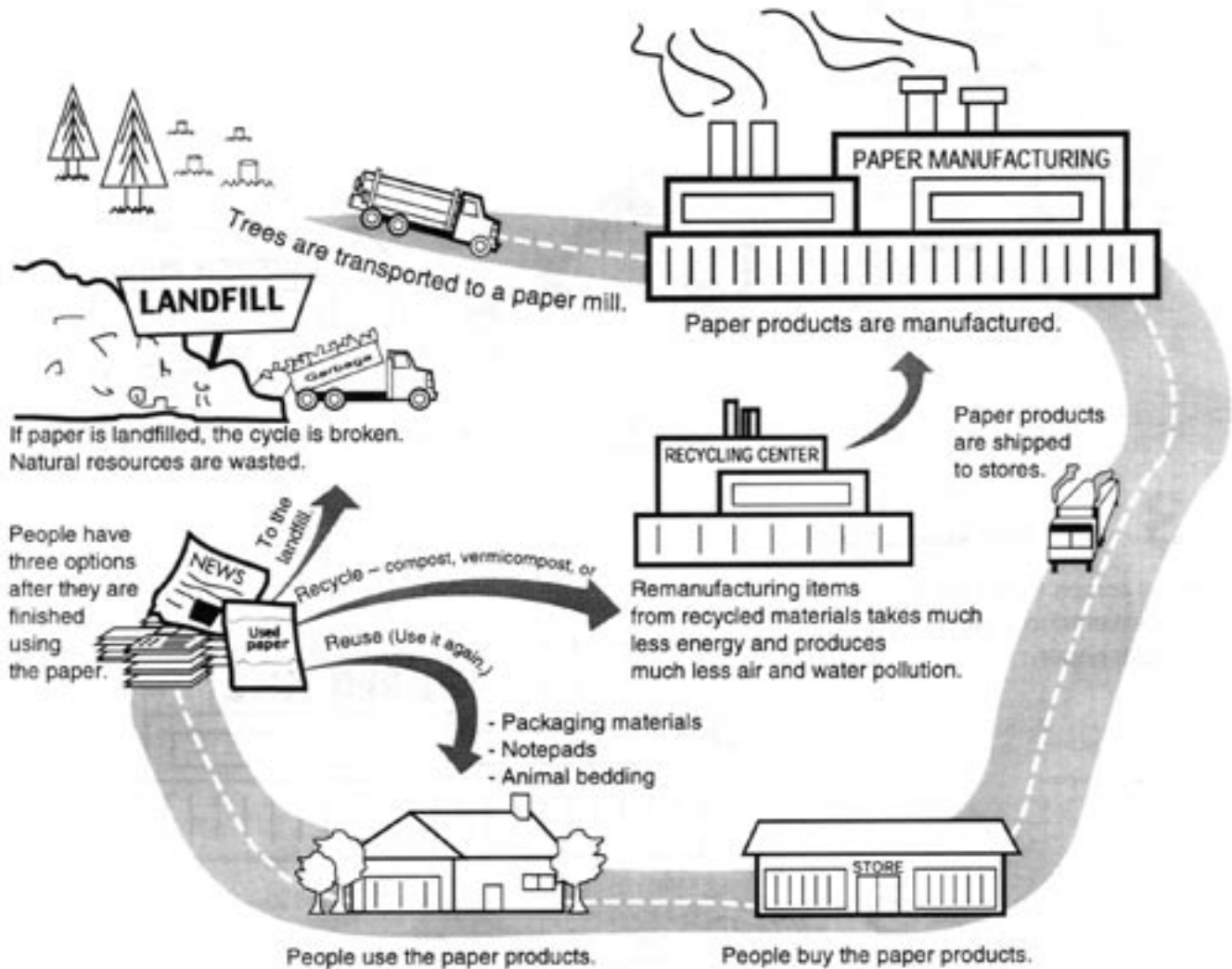
1. From what categories of natural resources was this item made?
2. Was it a living natural resource or a nonliving one?
 - a. If living, what natural resources did this living thing use when it was alive?
 - b. How did it get to the manufacturing plant where the item was made? What natural resources were used for its transportation?
 - c. What were the steps that led from the living natural resource to the item?
3. If not living, how was this item made? What natural resources were used for its transportation?
4. What other natural resources were needed to make the item?
5. Might any pollution be caused during the manufacturing process? If so, what natural resources might be polluted?
6. What happened to the item after it was made?
7. Who bought it?
8. Why was it bought?
9. How will it be used by the person who bought it?
10. How did the person get to and from the store where the item was bought and what natural resources were used for that purpose?
11. How long will this person probably keep the item?
12. What will happen to this item after the person no longer wants it?
13. If the item is headed to a landfill, what can be done to keep it from going to the landfill?
14. If the item is going to a landfill anyway, what natural resources would have been wasted in the making of this item?

Transparency and Student's Page

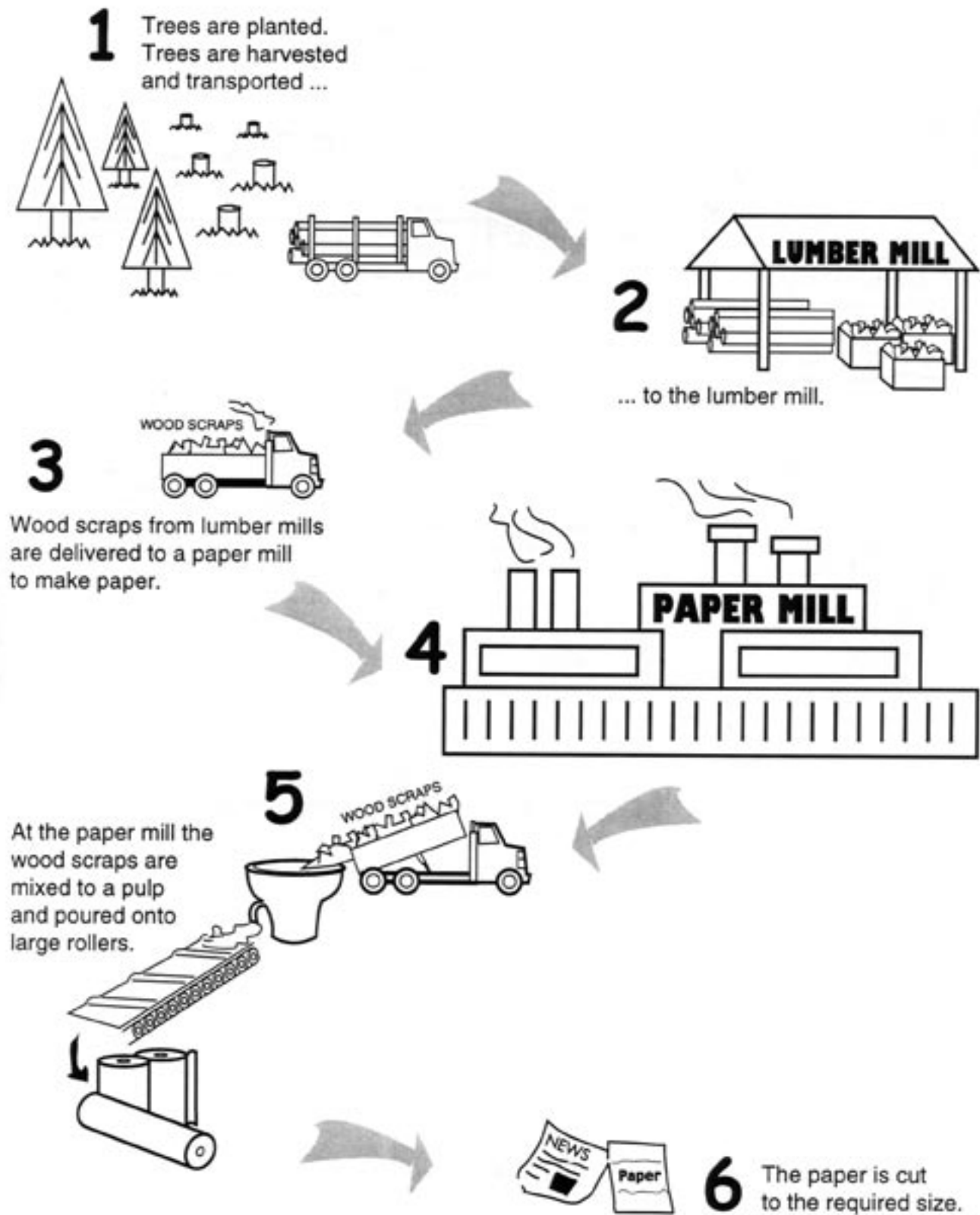
LIFE CYCLE OF A TREE



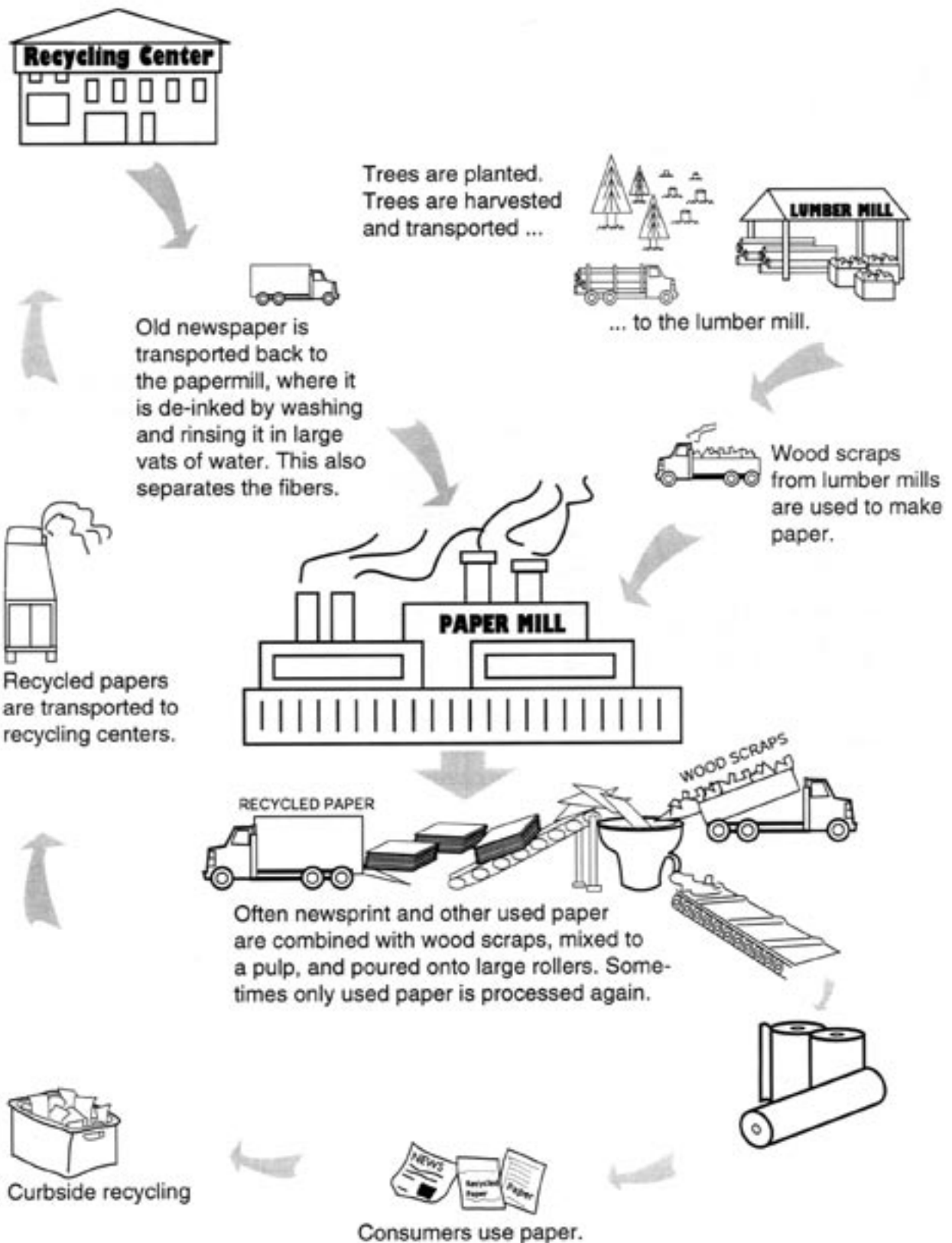
PAPERMAKING: ONE WAY OR A CYCLE?



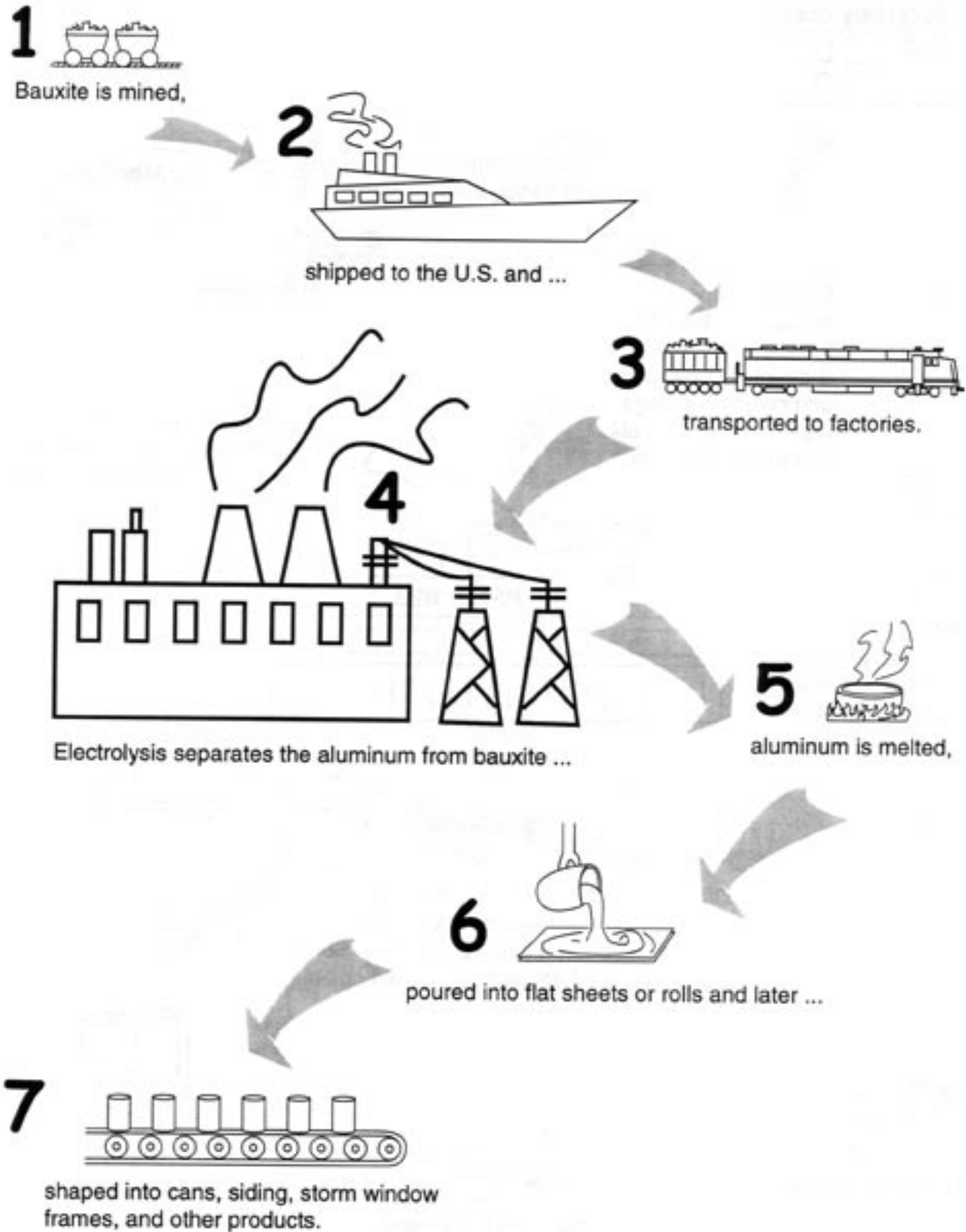
PAPER MANUFACTURING



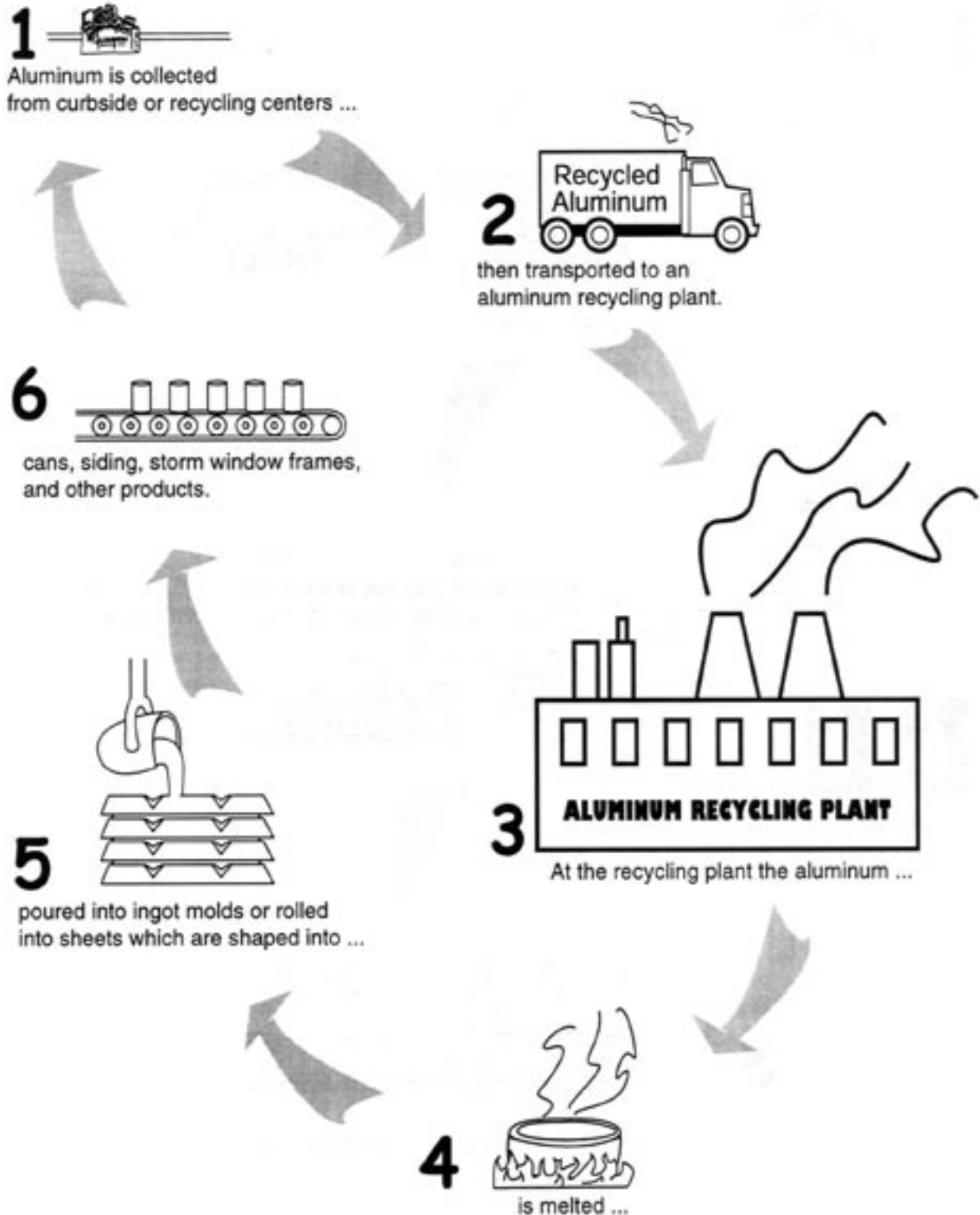
RECYCLED PAPER MANUFACTURING



ALUMINUM CAN MANUFACTURING

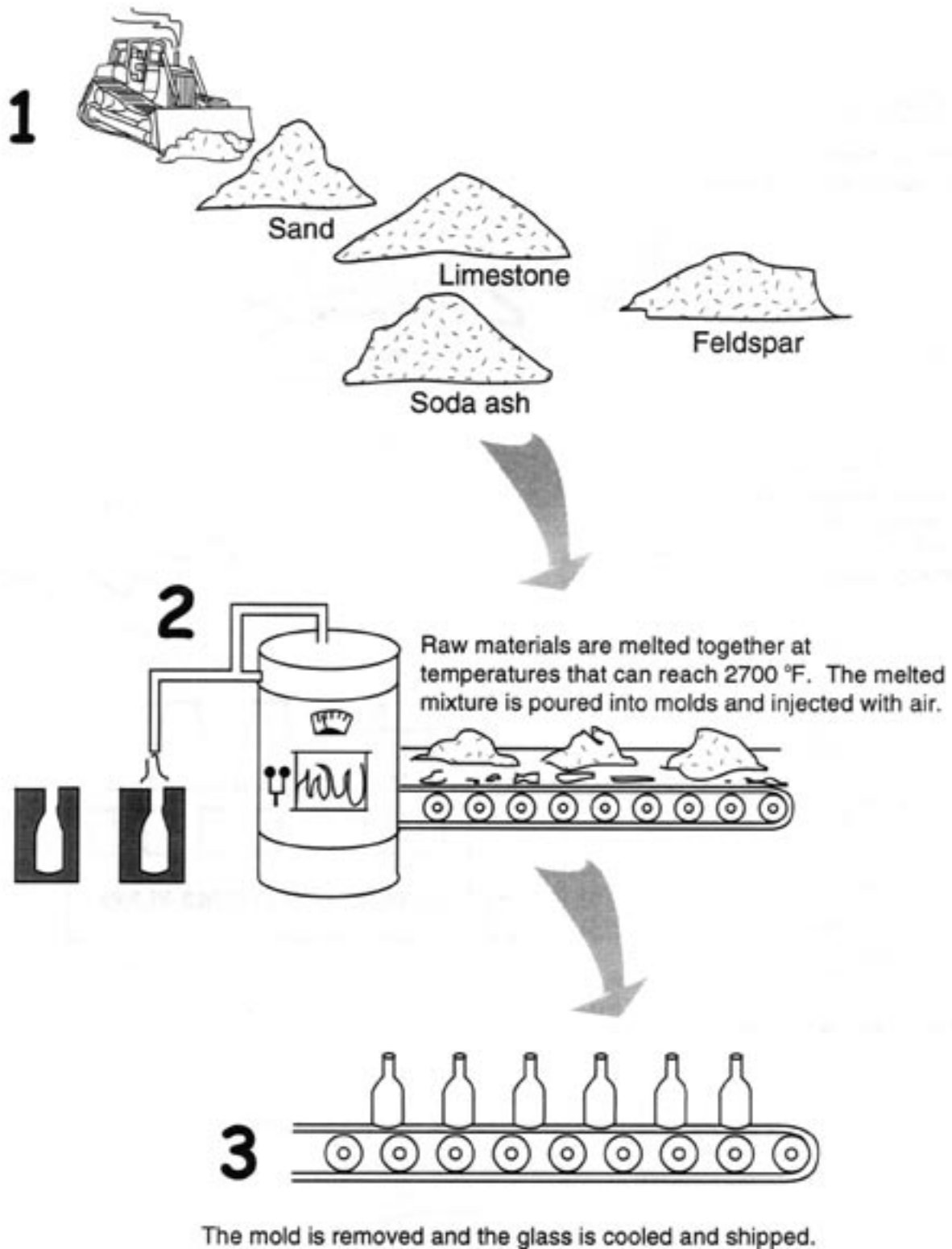


RECYCLED ALUMINUM MANUFACTURING

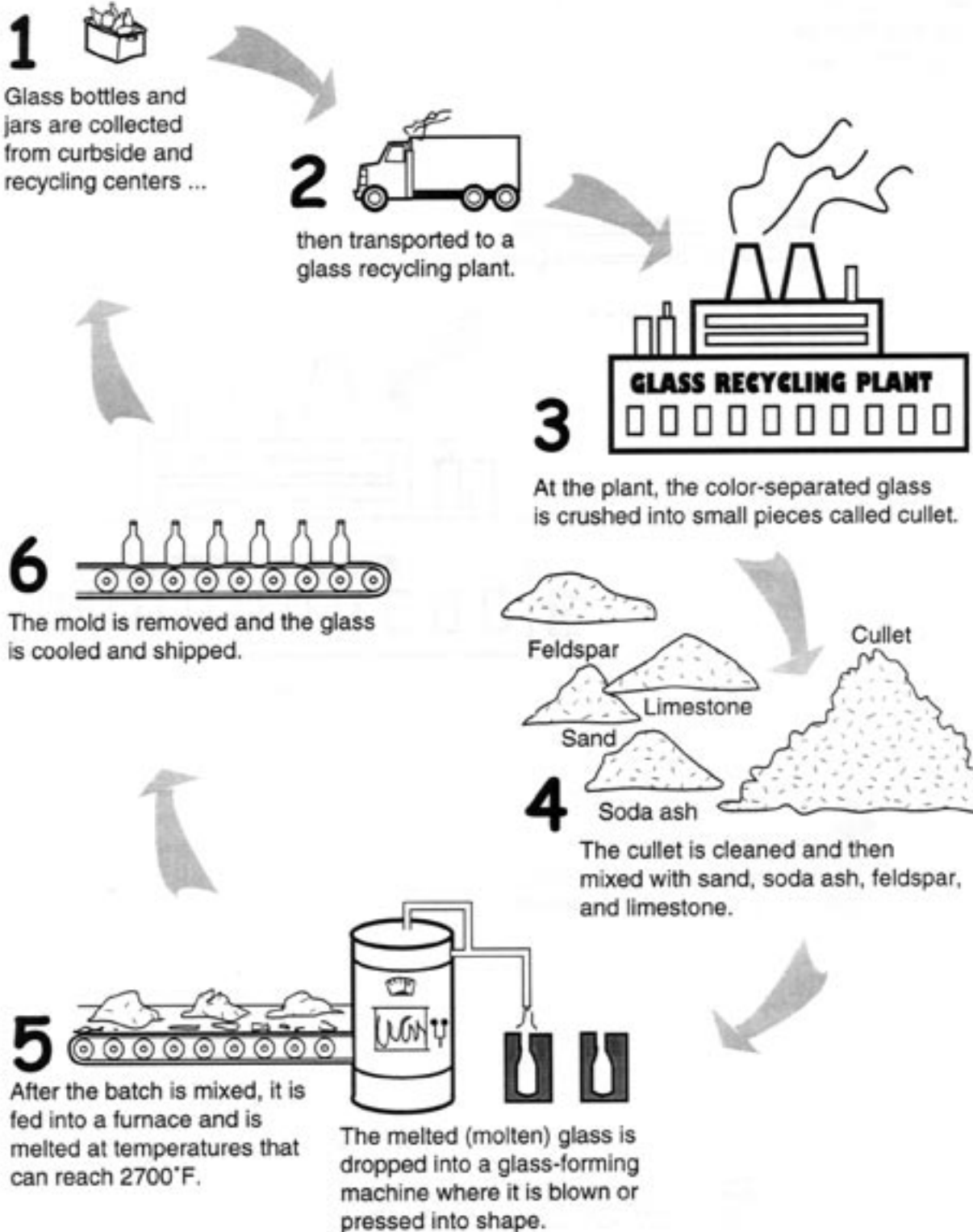


4-6 Module
Unit 1

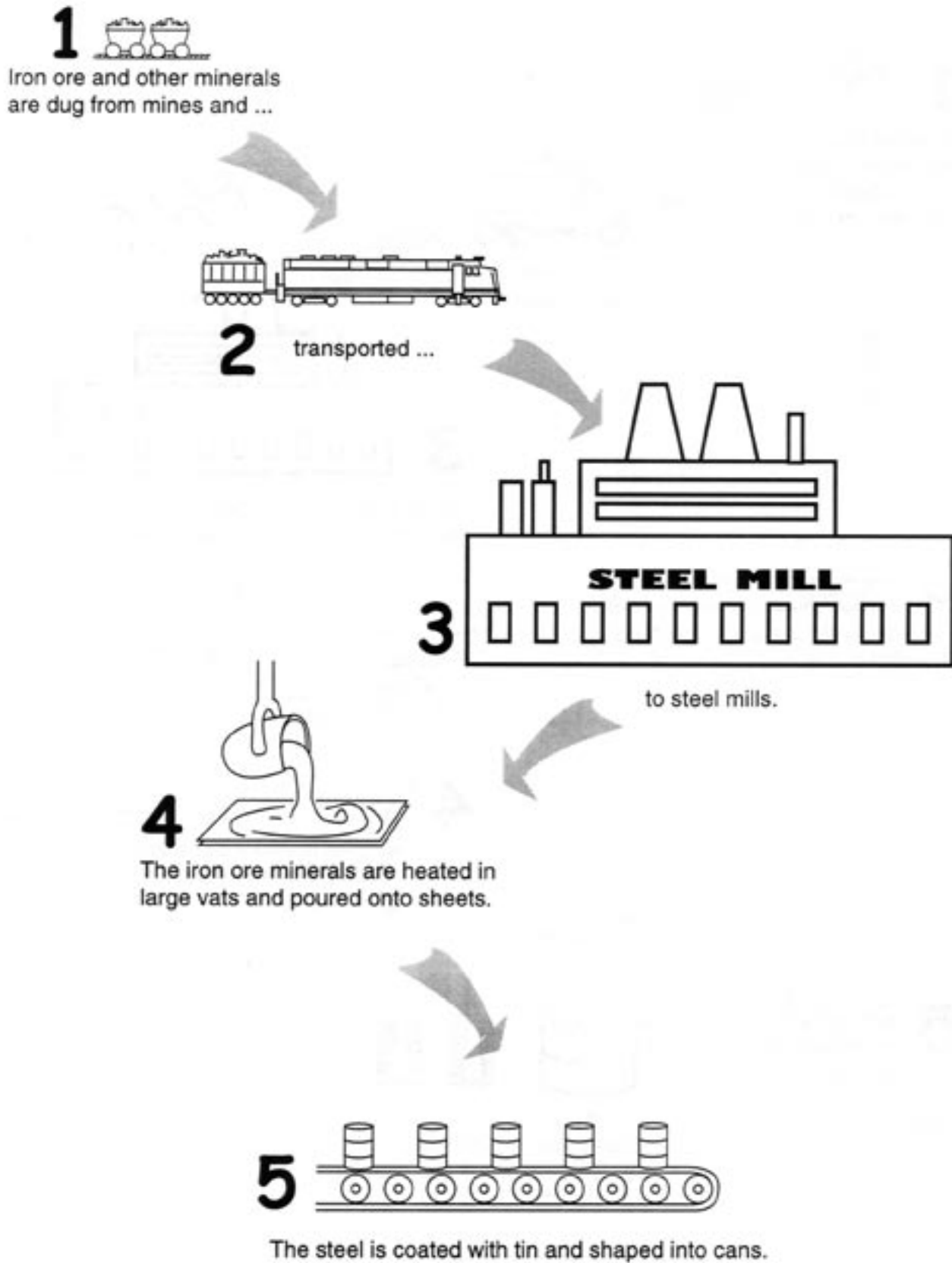
GLASS MANUFACTURING



RECYCLED GLASS MANUFACTURING



STEEL CAN MANUFACTURING



RECYCLED STEEL CAN MANUFACTURING



Empty steel cans are collected from curbside or recycling centers.



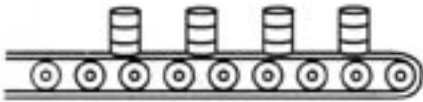
2



After the steel cans and other steel products are collected, they are transported ...



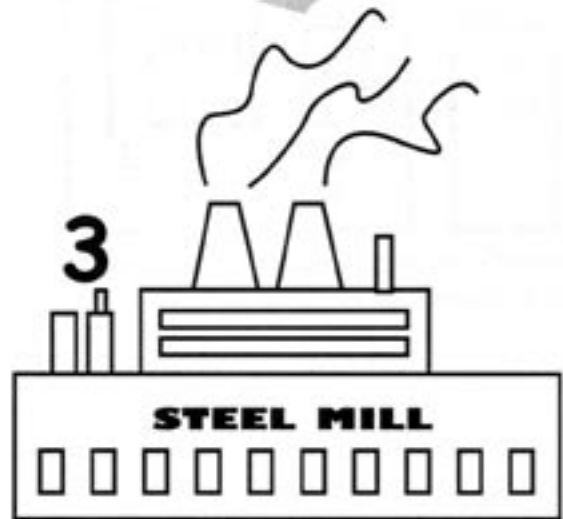
5



The steel is coated with tin and shaped into cans.

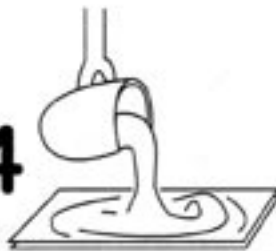


3



to steel mills.

4



The steel is heated in large vats and poured onto sheets



PLASTIC MANUFACTURING



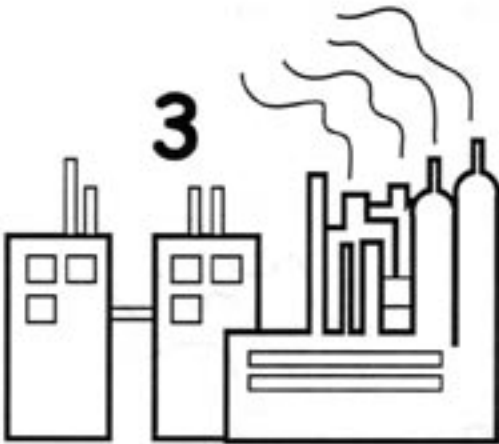
Oil wells pump the crude oil from the ground. Then it is ...

2



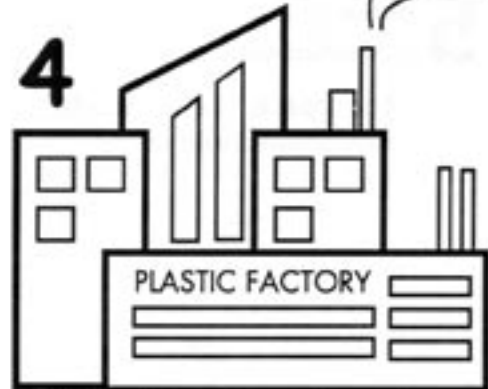
shipped and transported to refineries.

3



Petroleum and natural gas are mixed with chemicals to make resins.

4



Melted resins are used to make ...

5



thermoplastics and thermoset (permanently shaped) plastics.

RECYCLED PLASTIC MANUFACTURING



4-6 Module
Unit 1

BACKGROUND INFORMATION FOR THE TEACHER

Natural resources may undergo many processes (e.g., quarrying limestone, refining oil) between extraction and use. These steps often impact the environment in negative ways. To conserve natural resources and reduce the impact on the environment when extracting raw materials, communities need to reuse and recycle some human-made products. For example, used glass bottles can be washed and reused, or the used glass bottles can be crushed and melted and reformed to make new glass.

A life cycle is a series of stages through which something (e.g., an individual living thing or a manufactured product) passes during its lifetime. Through reusing and recycling, the life cycle of an object can be extended. This action conserves the natural resources (including energy sources) which would be used to replace this object, and the action also keeps the object out of the landfill.

If half of the paper used in the world today were recycled, three-quarters of the demand for new paper would be met. As a result, approximately ten million acres of forest destined for the paper industry could be conserved. At present, however, about three-quarters of used paper resources are wasted when they are placed in a landfill.

According to one estimate, when new paper is made from waste paper instead of trees, a large amount of water is conserved and 30 to 64 percent less energy is used. Also, 74 to 95 percent fewer air pollutants and 35 percent fewer water pollutants are added to the environment.¹

Reusing and recycling paper also helps to extend the life of landfills. Nearly one third of the waste stream by weight and over half by volume are made up of paper. Paper that has been used on one side can be reused by using the blank side for notepaper. Recycling one ton of used paper can save an average of two to three cubic yards of landfill space. For more information on paper, see "Appendix C–VII, Paper."

Using cullet (crushed recycled glass) saves energy because it melts at a lower temperature. For each 10 percent of cullet used, the furnace temperature can be lowered 10 degrees, and the batch in most cases can consist of up to 83 percent recycled

glass. Recently, several new glass manufacturing systems were developed that use nothing but glass cullet. Using one ton of recycled glass will save 1.2 tons of raw materials. According to one estimate, by using 50 percent recycled glass in manufacturing new glass, the manufacturer can cut water consumption in half; and air emissions, 14 percent. In addition, mining wastes can be decreased by 79 percent. For more information on glass, see "Appendix C–IV, Glass."

Recycling aluminum saves 95 percent of the energy required to produce it from raw materials (i.e., mine and process bauxite). Recycling an aluminum can saves the equivalent in fuel of that can half-filled with gasoline. In addition, 95 percent of the air pollution is eliminated, and 100 percent of the solid waste is diverted from landfills.²

Mining iron ore and producing steel can pollute the environment and is energy-intensive. Using scrap instead of raw iron ore to make new steel reduces air pollution by 86 percent and water pollution by 76 percent; saves 74 percent of the energy and 40 percent of the water that would have been used with raw materials; and reduces the need for raw materials by 90 percent. During the last ten years, improved steelmaking technologies, which yield less scrap, have increased the demand for purchased scrap by more than 50 percent. For more information see "Appendix C–III, Ferrous Metals."

Plastics are made from fossil fuels (oil and natural gas). Therefore, using recycled plastics conserves fossil fuels. The success of recycling plastics depends in part on the proper identification and separation of plastics. Polyethylene terephthalate (PETE) soda bottles and high-density polyethylene (HDPE) milk, juice, laundry detergent, and water containers are most often recycled, because they are made from one kind of plastic and are easily identifiable. HDPE jugs are shredded and remanufactured to make products such as plastic lumber. PETE soda bottles are shredded into fibers and woven back into threads to make clothing or are used to stuff sleeping bags, quilts, and parkas. (See the 4–6 Module, Unit 2, Lesson 7 for additional information and activities on plastics. Also, see "Appendix C–VIII.")

¹G. Tyler Miller, Jr., *Environmental Science: Working with the Earth* (Fifth edition). Belmont, Calif.: Wadsworth Publishing Company, 1995, p. 346.

²*Ibid.*, p. 345.